COMPUTER COMMUNICATION NETWORKS

LECT. NO. (I)

Course Title	**Computer Communication Networks**	
Course Code	**EEC4231**	
Academic Year	**2017-2018**	
Coordinator	**Dr. Roayat Ismail Abdelfatah**	
Teaching Staff	**Dr. Roayat Ismail Abdelfatah**	
Branch / Level	**--/ Fourth Year**	
Semester	**Second**	
Pre-Requisite	**--**	
Course Delivery	**Lecture 3**	**14 x 3=42 h lectures**
	Practical / Tutorial 2	**14 x 2=28 h practical /tutorial**
Parent Department	**Electronics and Electrical Communication Engineering**	
Date of Approval	**2/2/2018**	

Week	Topics
1	Classification of Communication Networks
2	Physical Layer
3	Analog and Digital Data Transmission,
4	Transmission Impairments
5,6	Bandwidth vs. Channel Capacity, Transmission Media
7,8	Data Encoding, Digital Data Communication Techniques
9	Asynchronous and Synchronous Transmission
10	Interfacing to Physical Layer
11	Data Link Layer , Network Layer ,Local Area Networks, protocols, and IEEE 802 standard & Transport Layer
12	Flow Control and Congestion Control in TCP ,Congestion Management
13	Internetworking & Connectionless Internetworking
14	The Internet Protocol, Routing Protocol, Satellite Networks &Packet Radio Networks

Assessment Method	Assessment Length	Schedule	Proportion
Written Examination	3h	On week 16	60%
Oral Assessment	15-30minuite	On week 15	10%
Practical Examination	15-30minuite	On week 15	10%
Semester work	5 hours (overall)	On week 5,9,12	20%

Essential Books:

1. Data Communication and Networking, 4th Edition, Behrouz Forouzan, 2007
2. Packet radio networks: architectures, protocols, technologies, and applications By Clifford A. Lynch,Edwin Blake Brownrigg,2005

Web sites:

http://williamstallings.com/DataComm
http://www.tutorialspoint.com/data_communication_computer_network/
http://www.comptechdoc.org/independent/networking/guide/

INTRODUCTION TO NETWORKS

OUTLINE

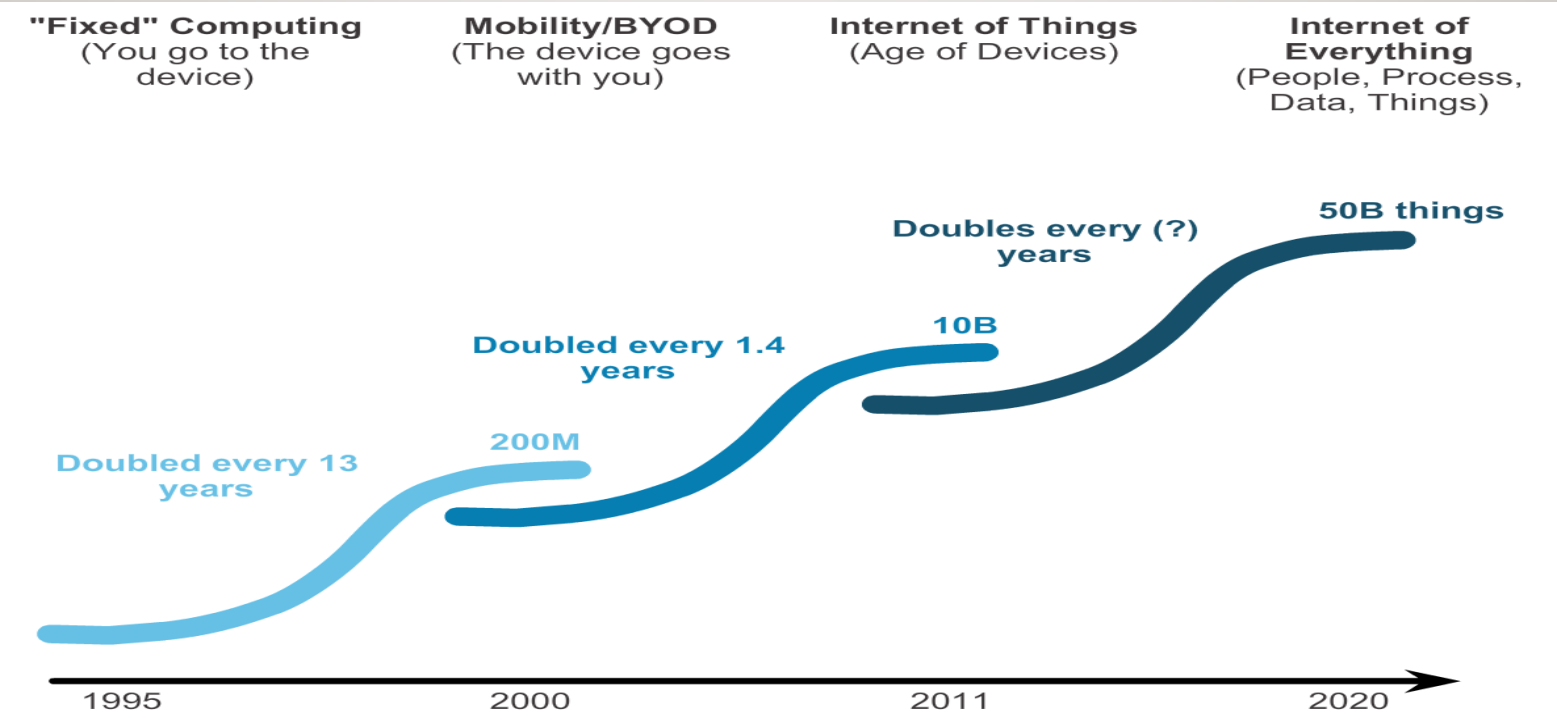
- History and advantages
- Computer networks structure
- Classes of computer networks
- Network topologies
- Data flow through networks

HISTORY

- In 1970s mainframes designed to serve a company on time share basis.
- In 1980s PCs become available
- The difficulties of sharing data among PCs motivated interconnecting them in a network.
- Nowadays PCs are interconnected easily and different preferals can also be attached to networks via wireless or wired

NETWORKING TODAY

NETWORKS IN OUR PAST AND DAILY LIVES



ADVANTAGES

- Interoperability (ability to mix different machines eg. Windows, Linux, Unix, Macs, etc)
- Sharing resources (eg printers, HDs, CPUs, etc)
- Increase reliability via backup copies for important data on different machines
- Economical

NETWORKING TODAY

THE GLOBAL COMMUNITY

INTERCONNECTING OUR LIVES

NETWORKING IMPACTS IN OUR DAILY LIVES

- Networks Support the Way We Learn
- Networks Support the Way We Communicate
- Networks Support the Way We Work
- Networks Support the Way We Play

PROVIDING RESOURCES IN A NETWORK

NETWORKS OF MANY SIZES

Small Home Networks

Small Office/Home Office Networks

Medium to Large Networks

World Wide Networks

CLASSES OF COMPUTER NETWORKS

- geographic extent
- Purpose
- implementation technology

LANS AND WANS

TYPES OF NETWORKS

The two most common types of network infrastructures are:

- Local Area Network (LAN)
- Wide Area Network (WAN).

Other types of networks include:

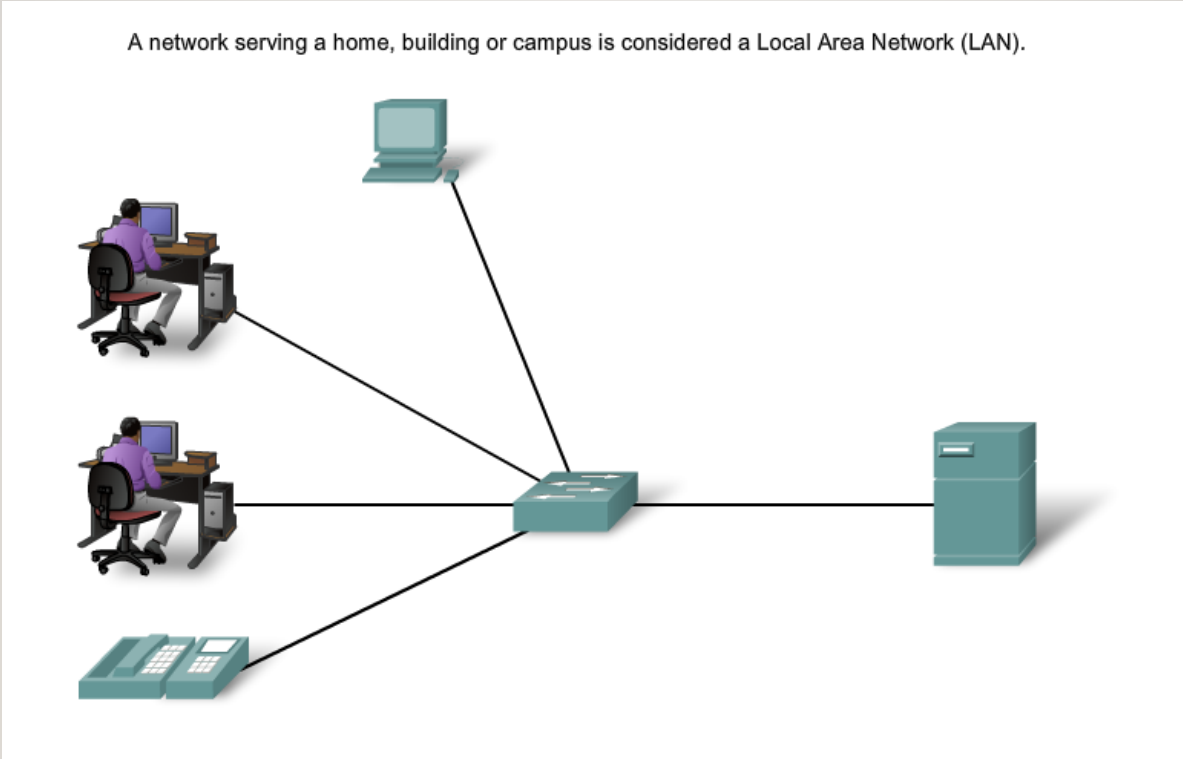
- Metropolitan Area Network (MAN)
- Wireless LAN (WLAN)

LAN

- LAN is owned by a single organization. This localized control increases flexibility in decision.
- Usually, high quality, high-speed communication links are used.
- Consequently, the error rate is much lower than other networks. The transmission speed is high as 1- 50 Mbps for twisted pair or coaxial, while for optical fiber it is hundreds of Mbps.
- Typical example networks are Ethernet, Cambridge ring, Novell, etc.

LANS AND WANS

LOCAL AREA NETWORKS (LAN)



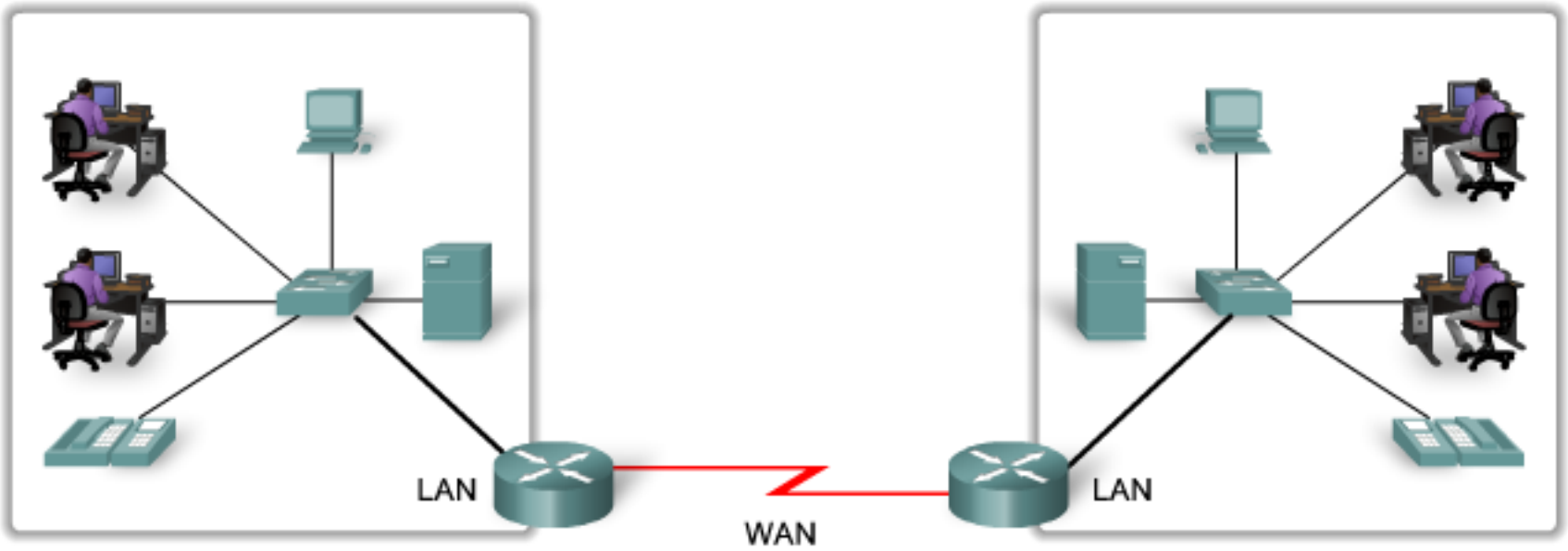
WAN

- Transmission rates are less than 1 Mbps (typically 56 kps) or less.
- The transmission quality is poorer than LANs as WAN uses transmission facilities of the telephone network which is originally designed for carrying voice traffic nor than data.
- Consequently, the error rate is high.
- The transmission delay is greater than LANs due to the large coverage area.
- Routing algorithms are important due to the complicated geometry of the network.
- Flow control is necessary due to the different transmission speeds of the different communication media and nodes along the path between the source and the destination
- Also, recovery from transmission errors is required, and hence error control is inevitable.
- Typical example networks are: air-line seat reservations, ARPANet, Internet, etc.

LANS AND WANS

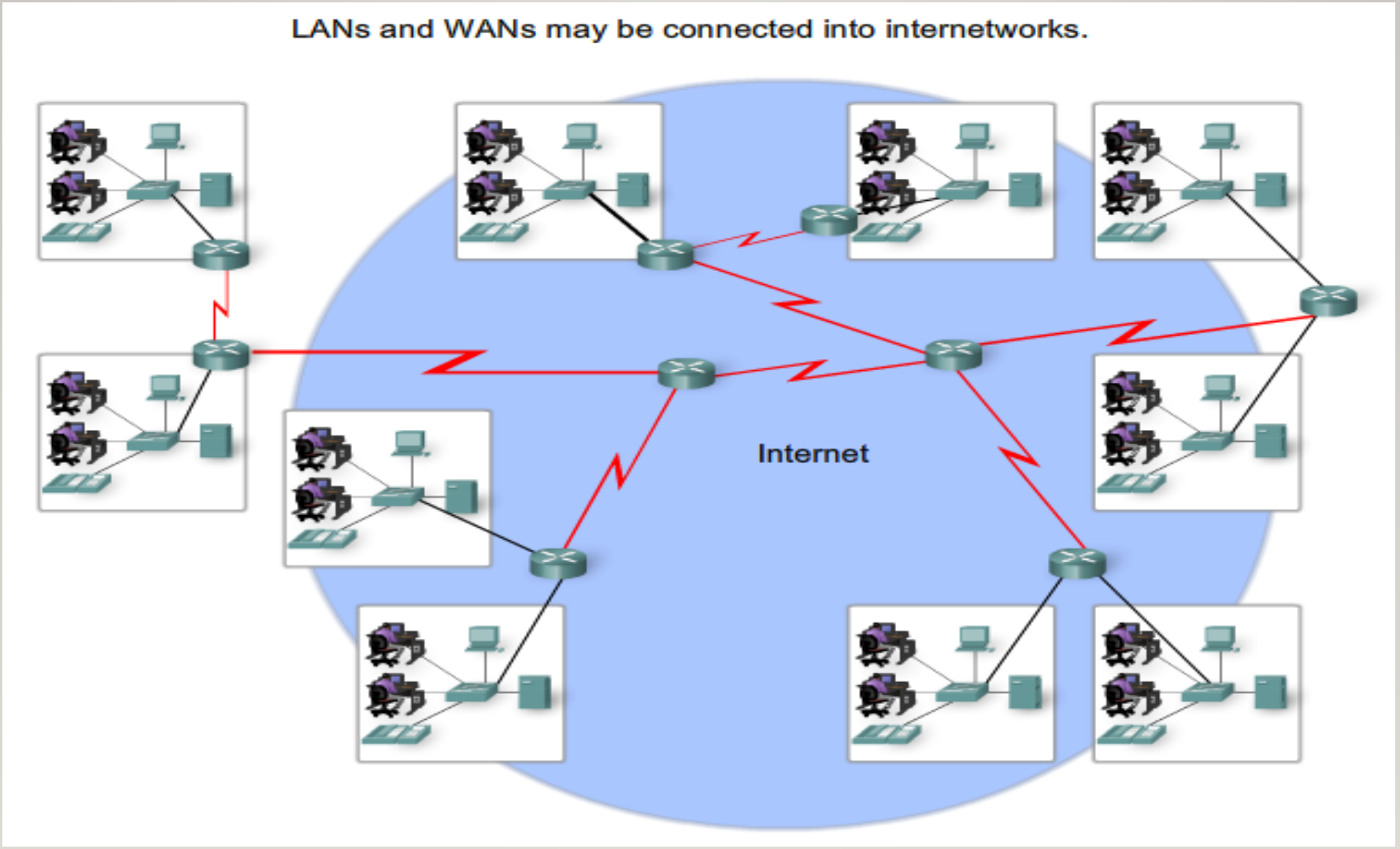
WIDE AREA NETWORKS (WAN)

LANs separated by geographic distance are connected by a network known as a Wide Area Network (WAN).



LANS, WANS, AND INTERNETS

THE INTERNET

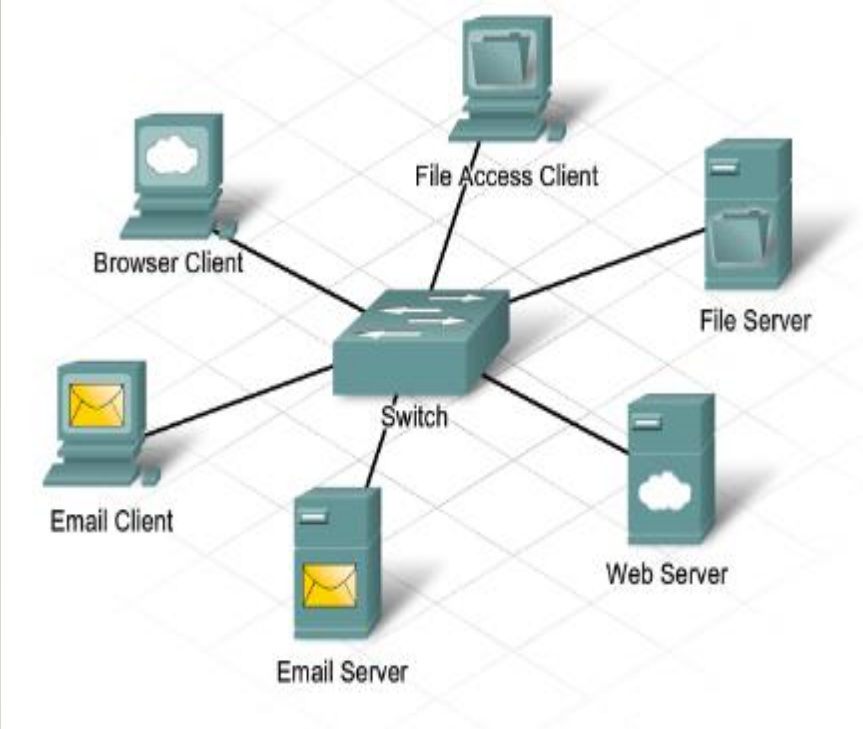


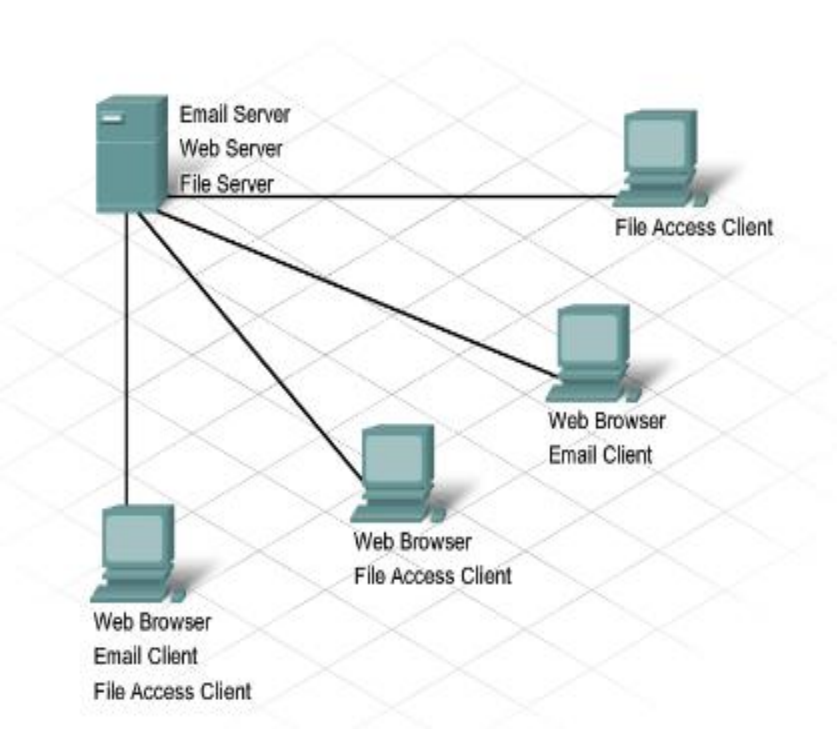
MAN

- It spans distances between 10 – 100 km.
- Its coverage area is a city, a town or a small country as shown in Fig. 1.9.
- It is sometimes called a long-haul network.
- It is developed to support data, voice and video using the LAN technology.
- Its transmission speed is on the average of 1 Mbps.
- The most common media of MAN are coaxial cables or optical fiber.
- Usually, it is used to connect many LANs.
- A typical example network is Fiber Distributed Data Interface (FDDI).

PROVIDING RESOURCES IN A NETWORK

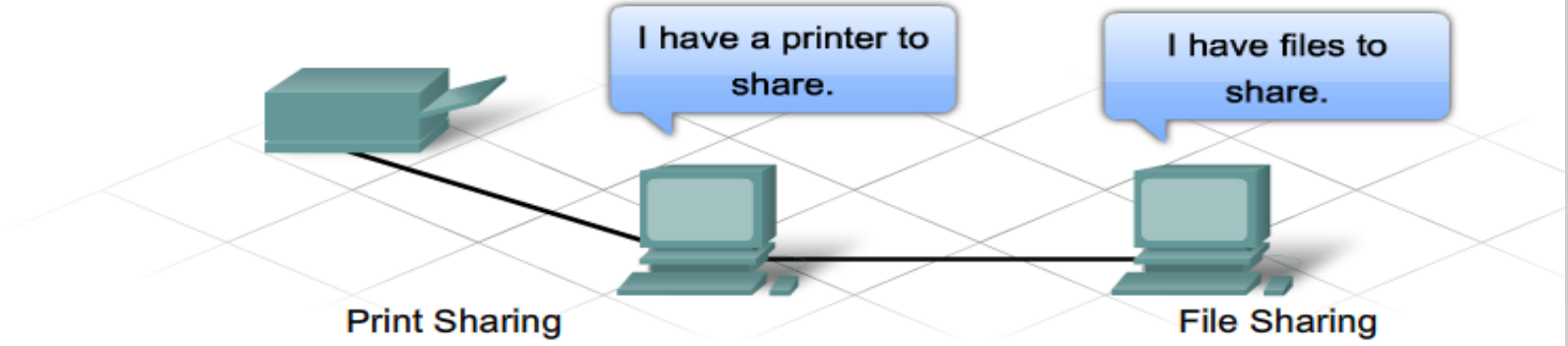
CLIENTS AND SERVERS





PROVIDING RESOURCES IN A NETWORK

PEER-TO-PEER



The advantages of peer-to-peer networking:

- Easy to set up
- Less complexity
- Lower cost since network devices and dedicated servers may not be required
- Can be used for simple tasks such as transferring files and sharing printers

The disadvantages of peer-to-peer networking:

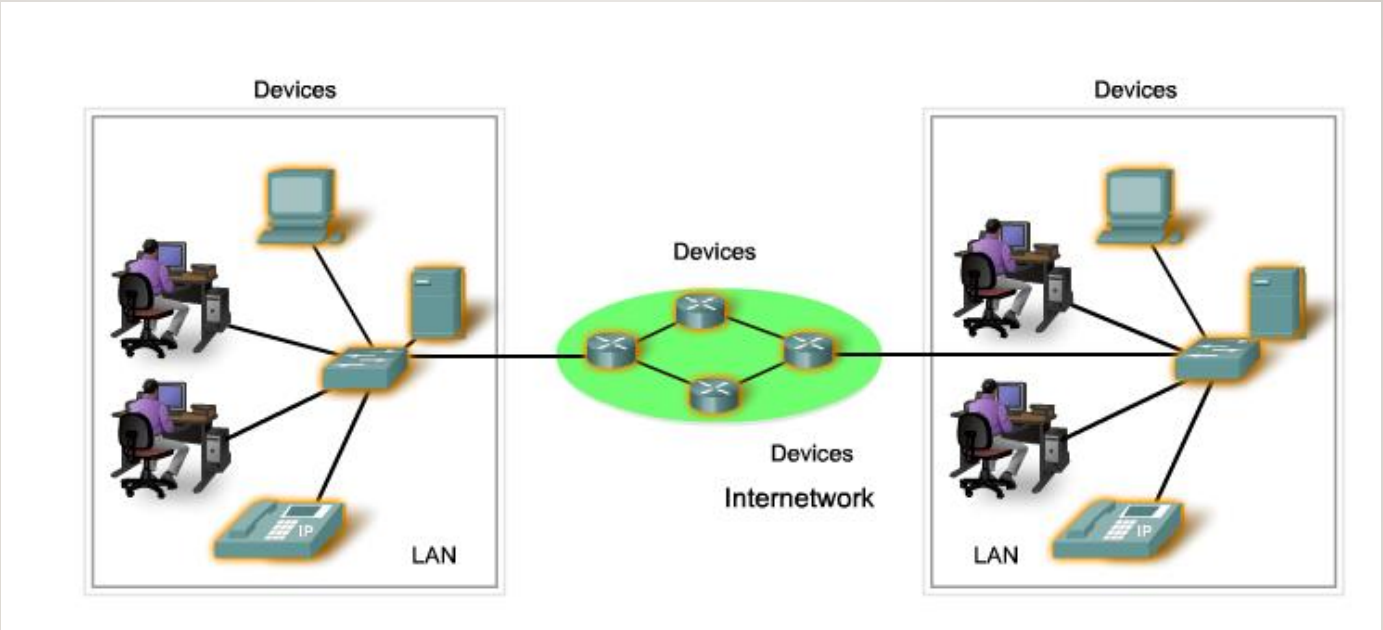
- No centralized administration
- Not as secure
- Not scalable
- All devices may act as both clients and servers which can slow their performance

LANS, WANS, AND INTERNETS

COMPONENTS OF A NETWORK

There are three categories of network components:

- Devices
- Media
- Services



COMPONENTS OF A NETWORK

END DEVICES

Some examples of end devices are:

- Computers (work stations, laptops, file servers, web servers)
- Network printers
- VoIP phones
- Security cameras
- Mobile handheld devices (such as smartphones, tablets, PDAs, and wireless debit / credit card readers and barcode scanners)

COMPONENTS OF A NETWORK

NETWORK INFRASTRUCTURE DEVICES

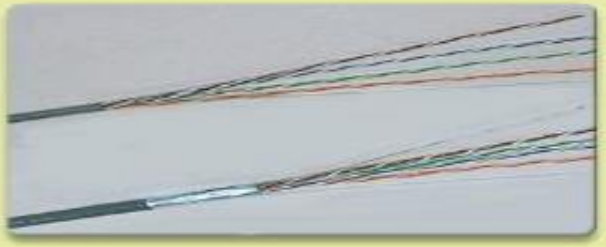
Examples of intermediary network devices are:

- Network Access Devices (switches, and wireless access points)
- Internetworking Devices (routers)
- Security Devices (firewalls)

COMPONENTS OF A NETWORK

NETWORK MEDIA

Copper

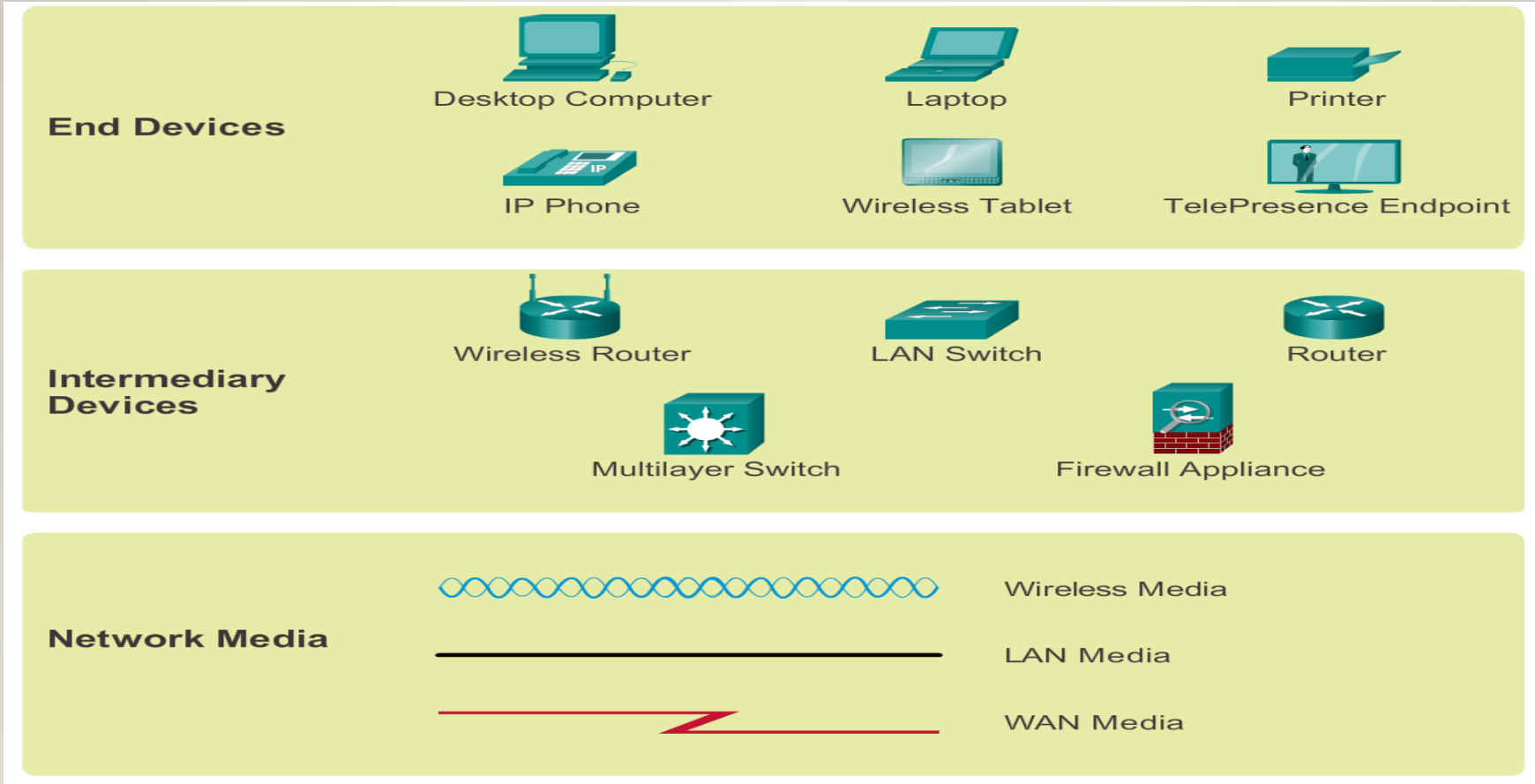


Fiber Optic

Wireless

COMPONENTS OF A NETWORK

NETWORK REPRESENTATIONS



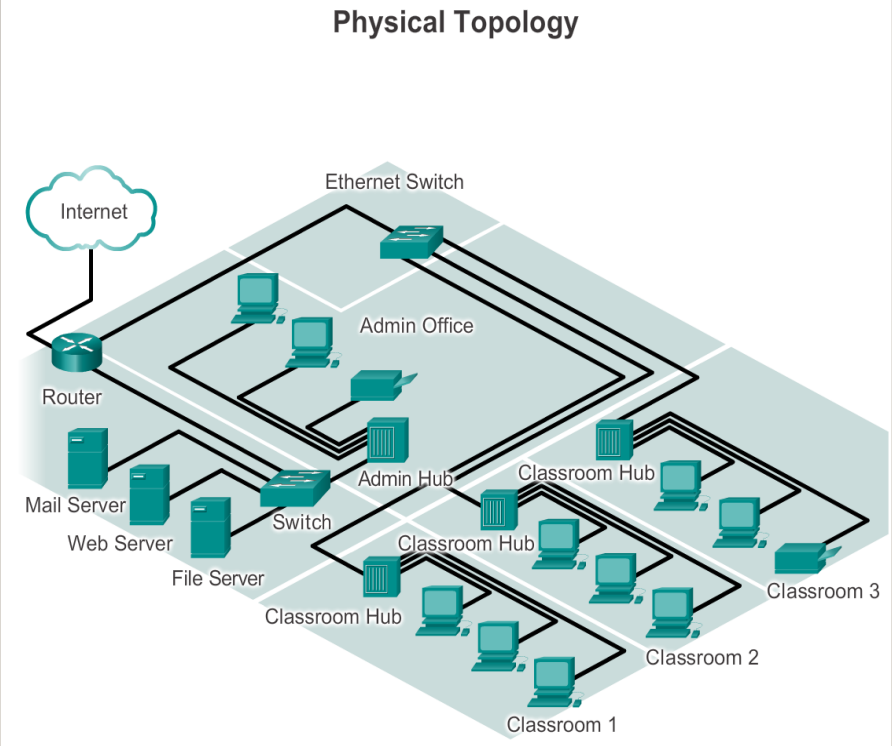
NETWORK TOPOLOGIES

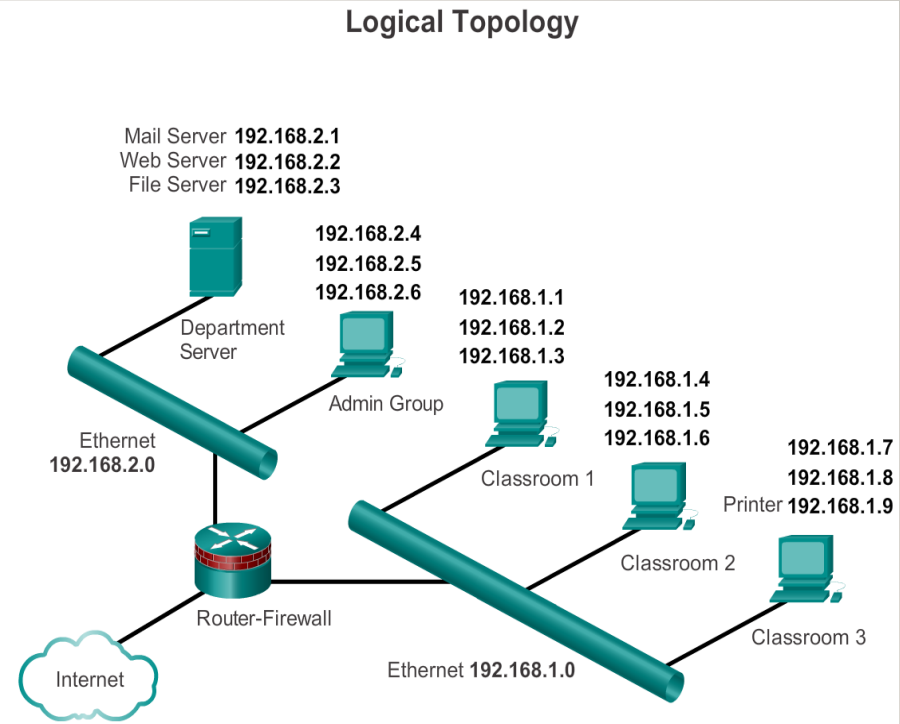
- physical
- Logical

- Choosing of a certain topology is according to cost, flexibility, and reliability

COMPONENTS OF A NETWORK

TOPOLOGY DIAGRAMS

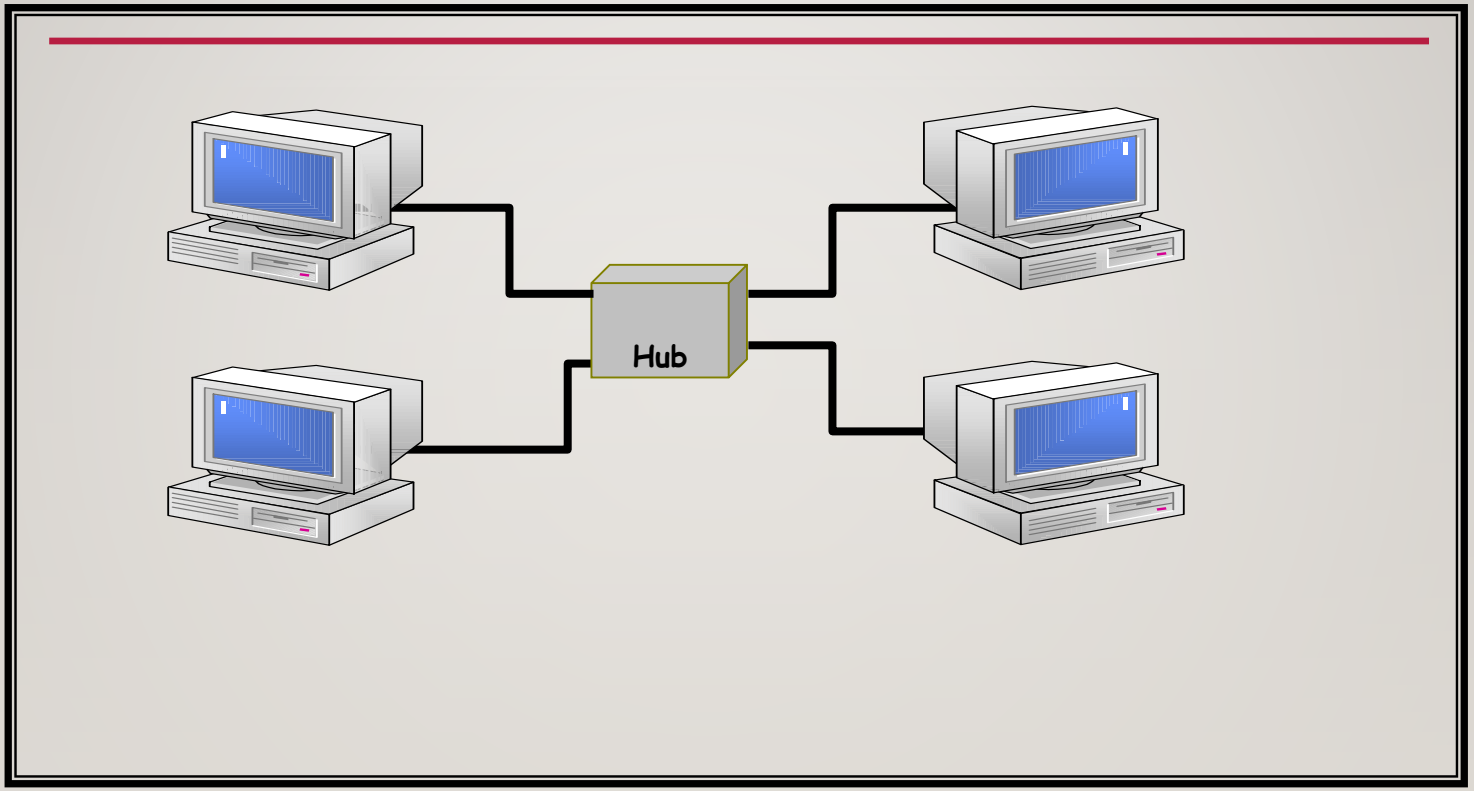




NETWORK TOPOLOGIES

- Star
  - ✓ Cable layouts are easy to modify.
  - ✓ Defective communication lines are easily identified.
  - ✓ There is no possibility of data collision.
  - ✓ Workstations can be added to network easily
  - ✗ It uses a large amount of cable.
  - ✗ It is unsuitable for peer-to-peer communications.
  - ✗ Central node dependency

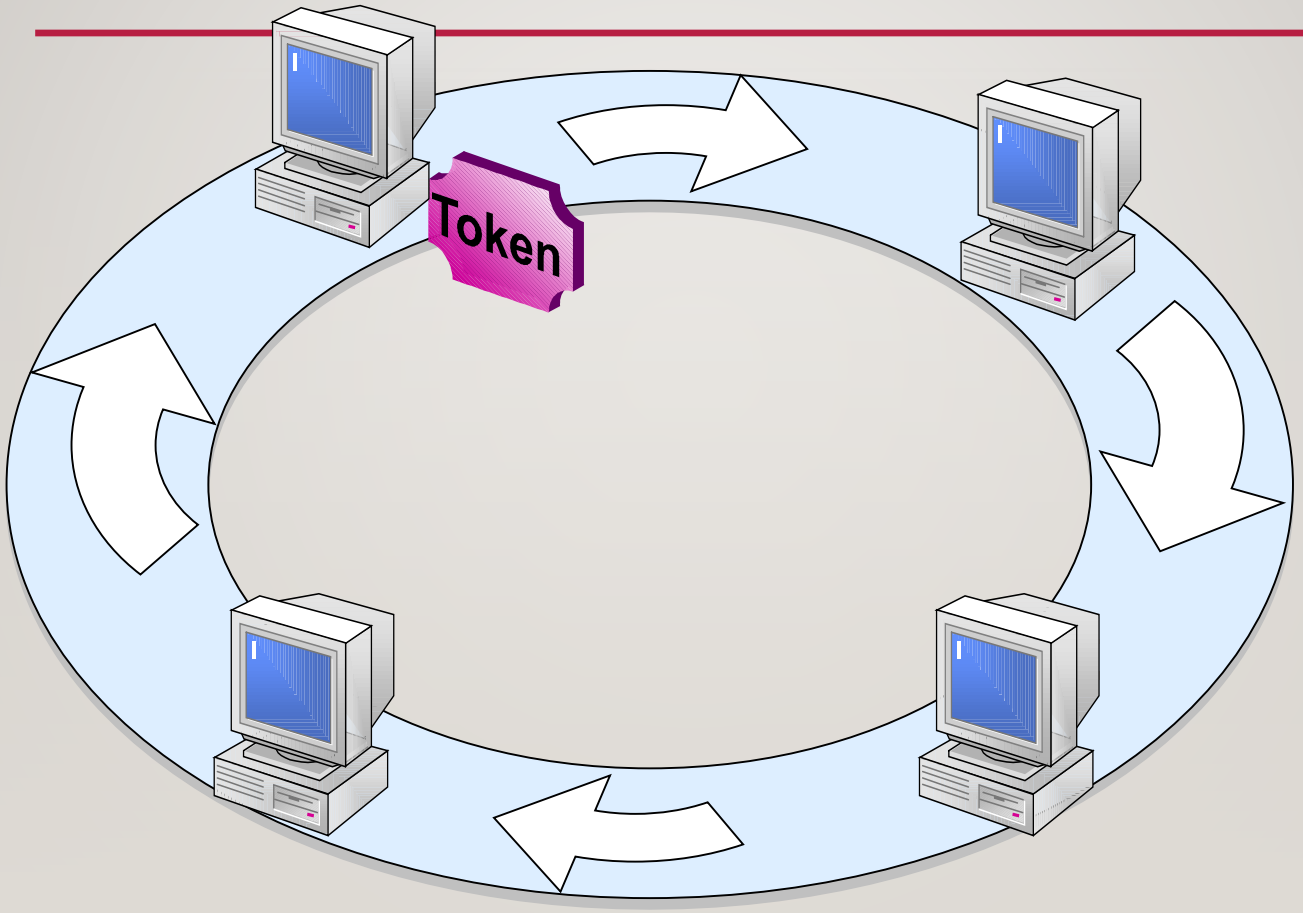
STAR



NETWORK TOPOLOGY

- Ring
  - ✓ It uses short cable length
  - ✓ It is suitable for optical fiber
  - ✓ It is easy to implement priority
  - ✗ Node failure causes network failure.
  - ✗ It is difficult to diagnose faults.
  - ✗ It is not possible to shut down a small section of the ring while keeping the majority of it working normally, "All or nothing of the ring".

RING



NETWORK TOPOLOGY

- Bus
  - ✓ It uses the least amount of cable length and simplest wiring layout.
  - ✓ It has the lowest priced technology.
  - ✓ It is easy to extend, so additional nodes can be connected at any point along the length. Sometimes repeater is used.
  - ✓ The failure of any station does not affect the operation of others.
  - ✗ It does not support adequately large number of heavy users.
  - ✗ It is difficult to implement priority.

BUS

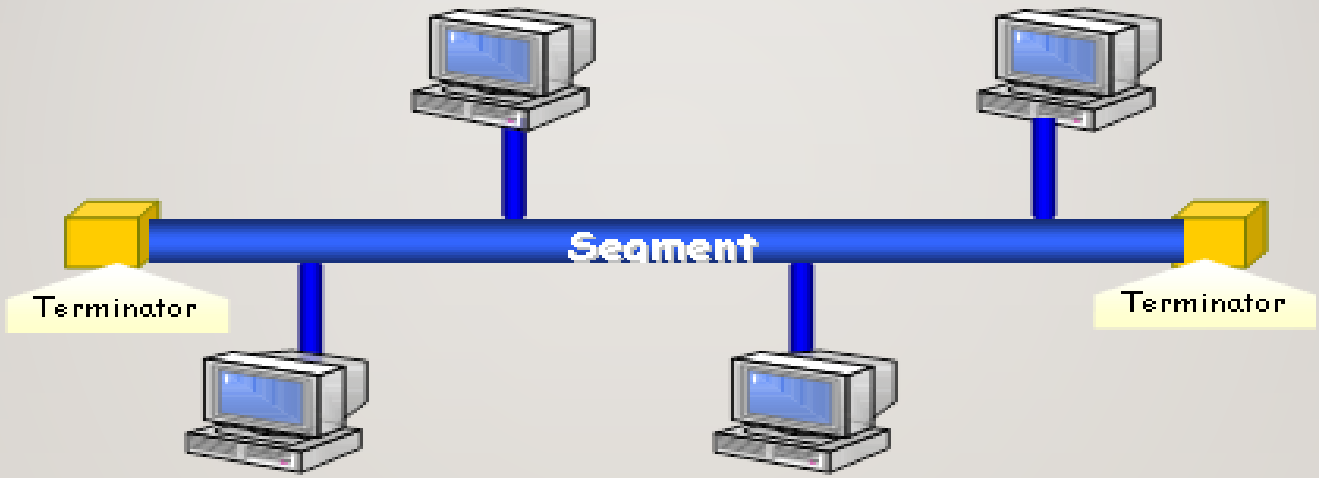


Fig. 1.12: Bus or linear topology.

HYBRID

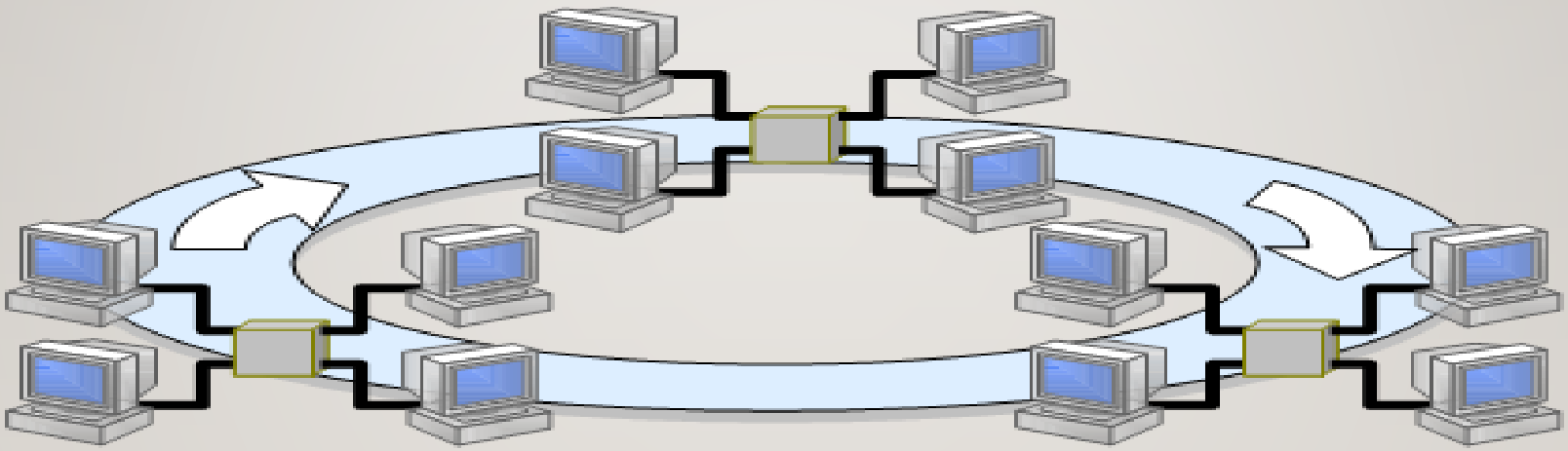
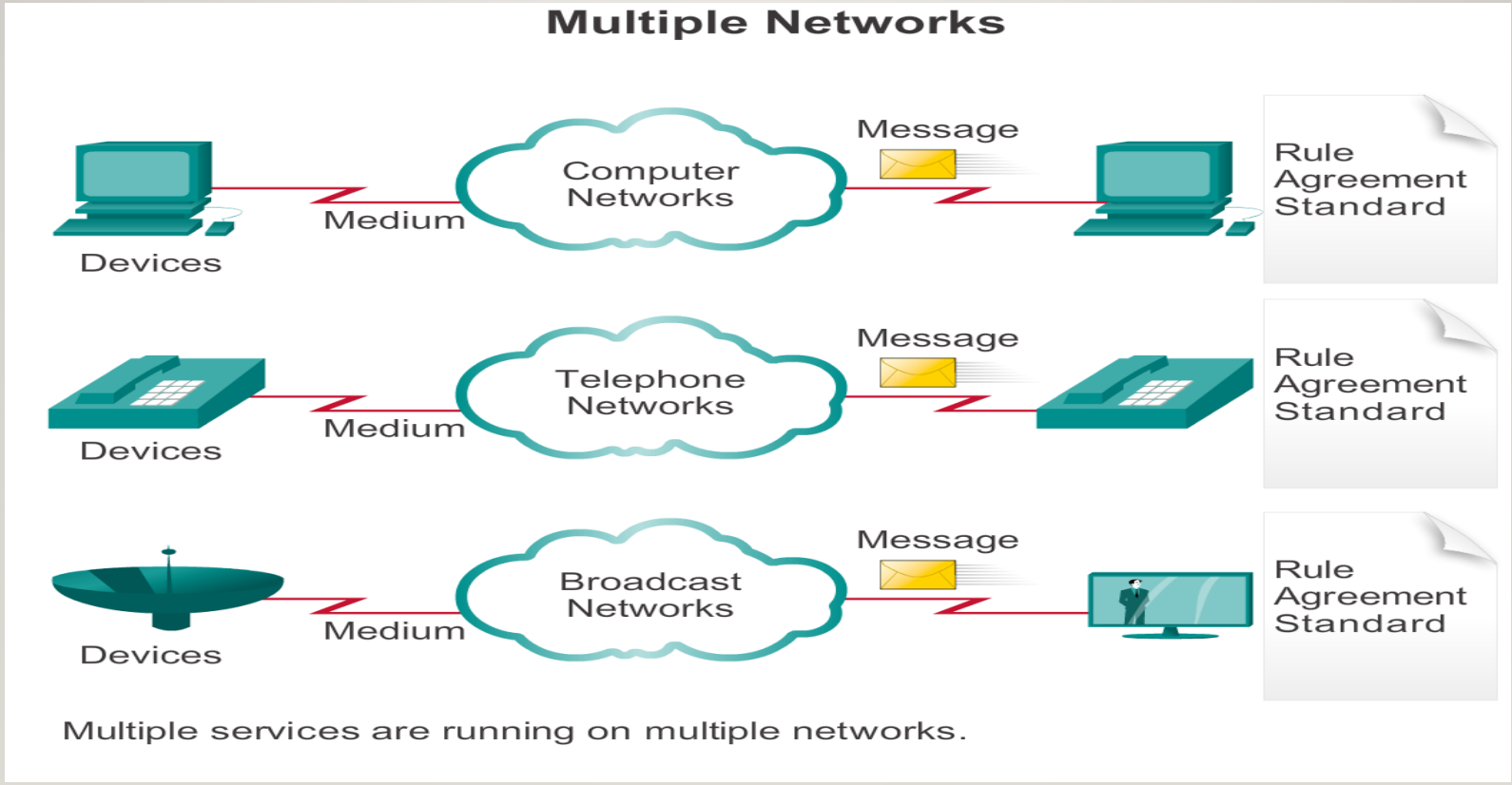


Fig. 1.14: Ring-Star hybrid topology.

CONVERGED NETWORKS

THE CONVERGING NETWORK



RELIABLE NETWORK

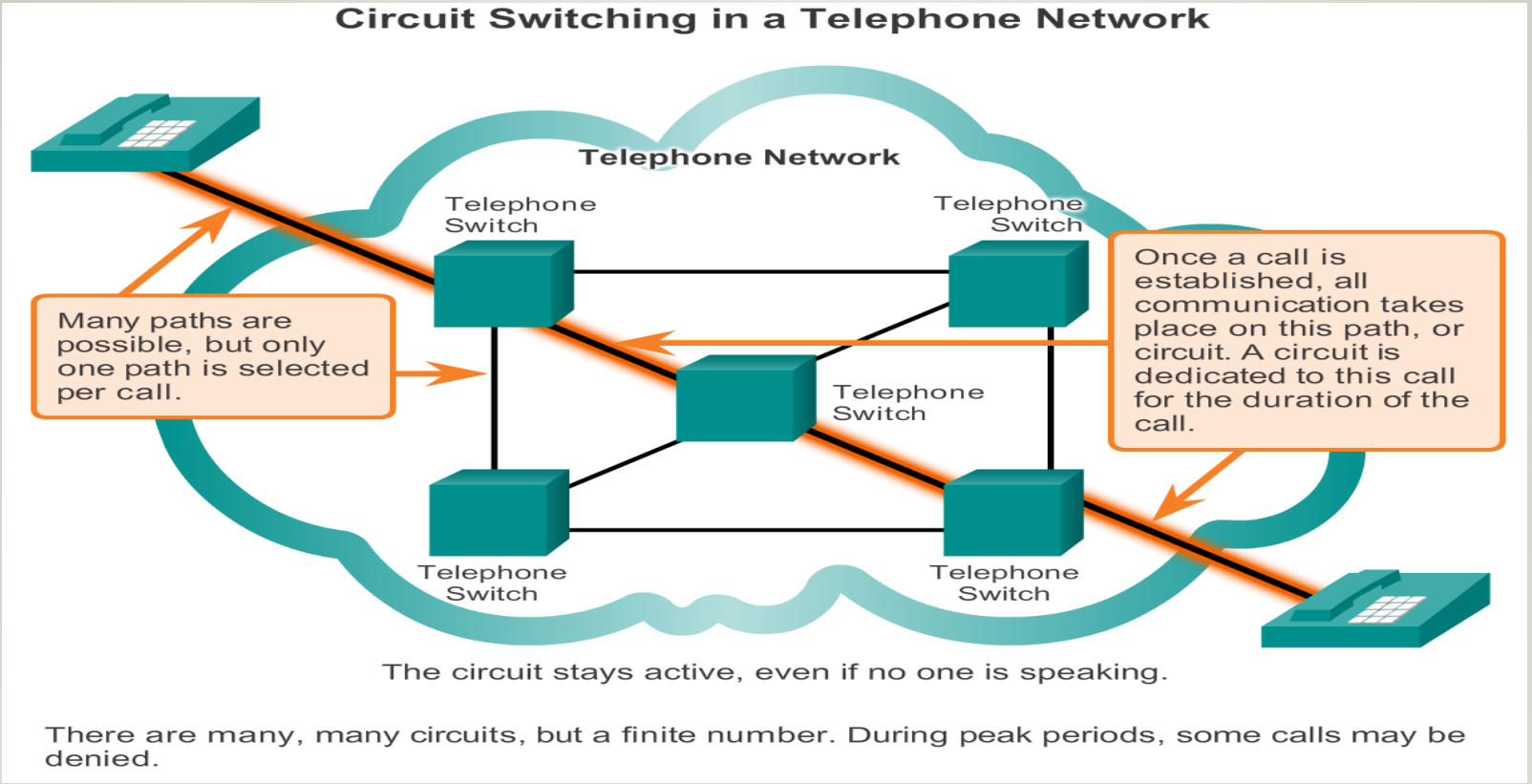
SUPPORTING NETWORK ARCHITECTURE

As networks evolve, we are discovering that there are four basic characteristics that the underlying architectures need to address in order to meet user expectations:

- Fault Tolerance
- Scalability
- Quality of Service (QoS)
- Security

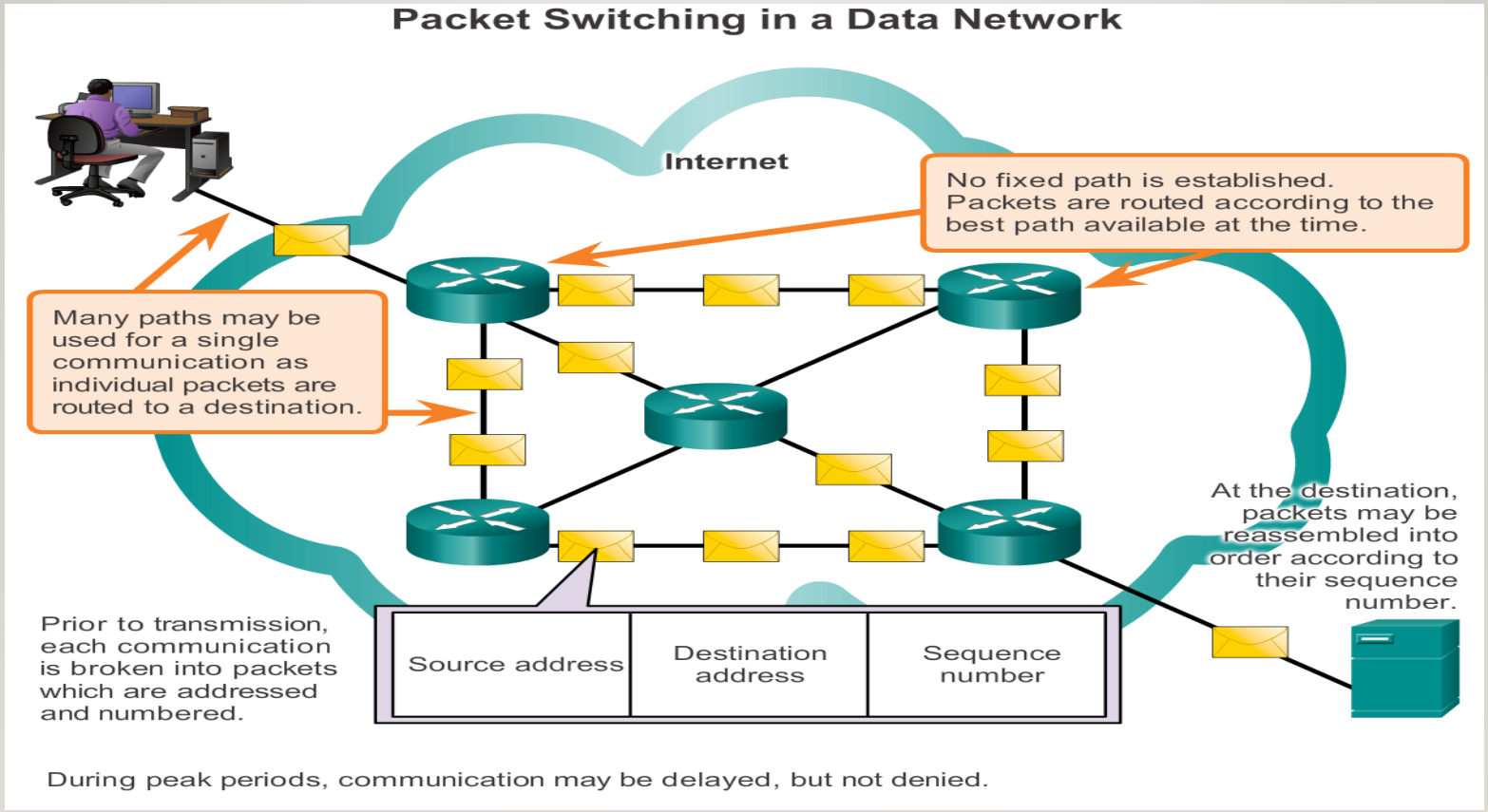
RELIABLE NETWORK

FAULT TOLERANCE IN CIRCUIT SWITCHED NETWORK



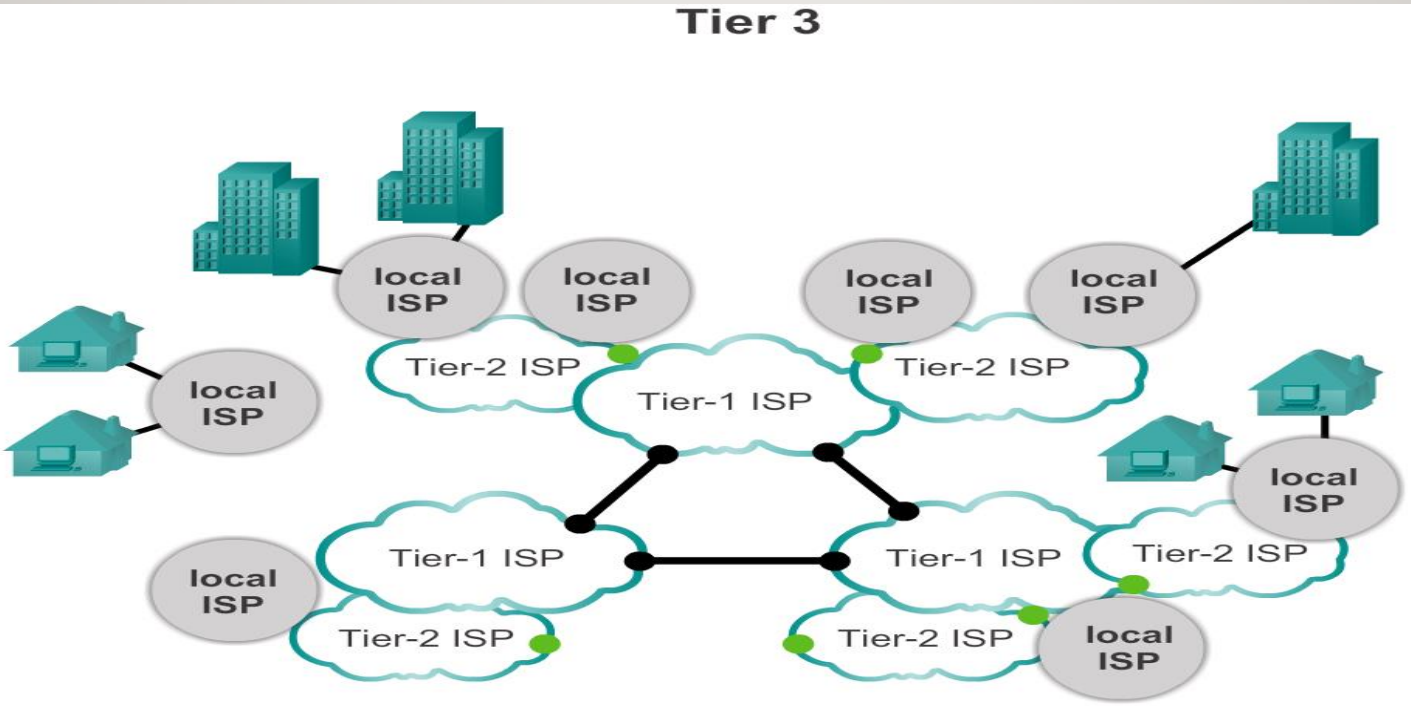
RELIABLE NETWORK

PACKET-SWITCHED NETWORKS



RELIABLE NETWORK

SCALABLE NETWORKS



RELIABLE NETWORK

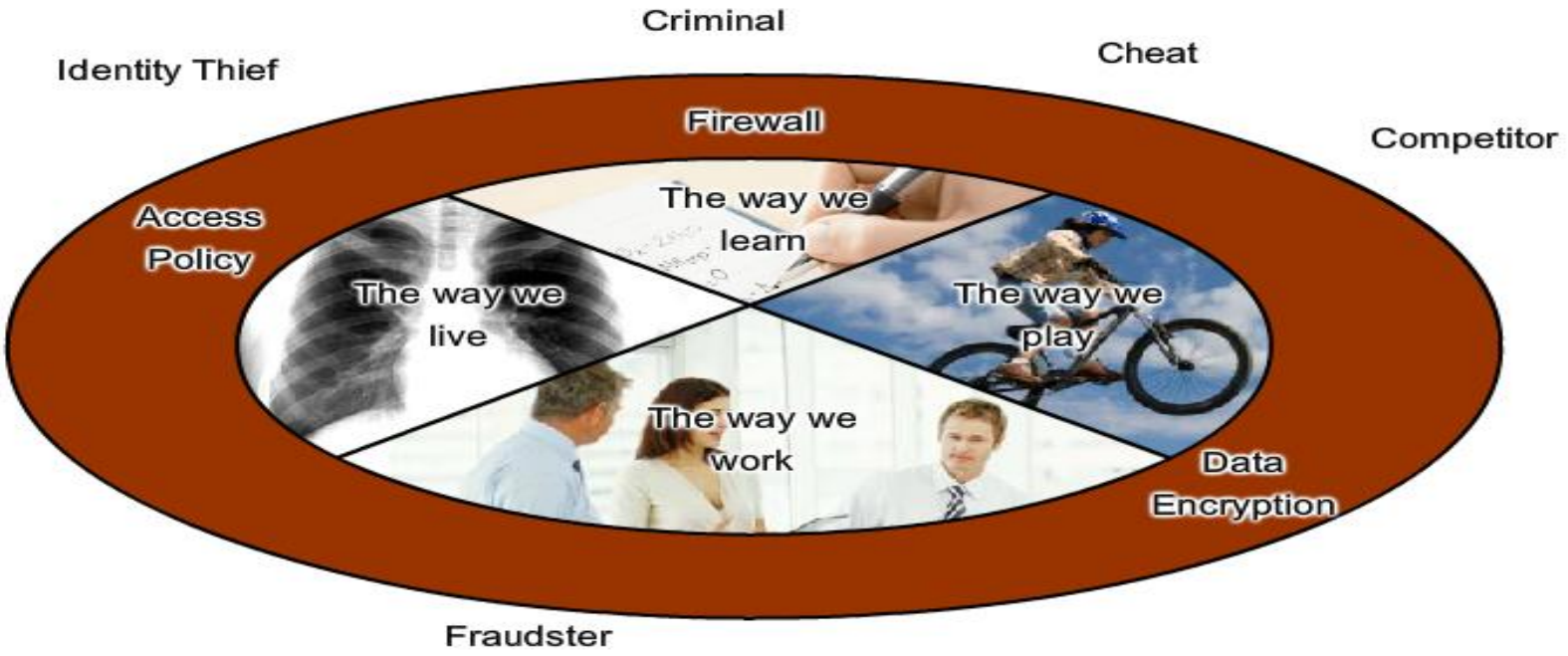
PROVIDING (QOS)

Examples of priority decisions for an organization might include:

- Time-sensitive communication - increase priority for services like telephony or video distribution.
- Non time-sensitive communication - decrease priority for web page retrieval or email.
- High importance to organization - increase priority for production control or business transaction data.

RELIABLE NETWORK

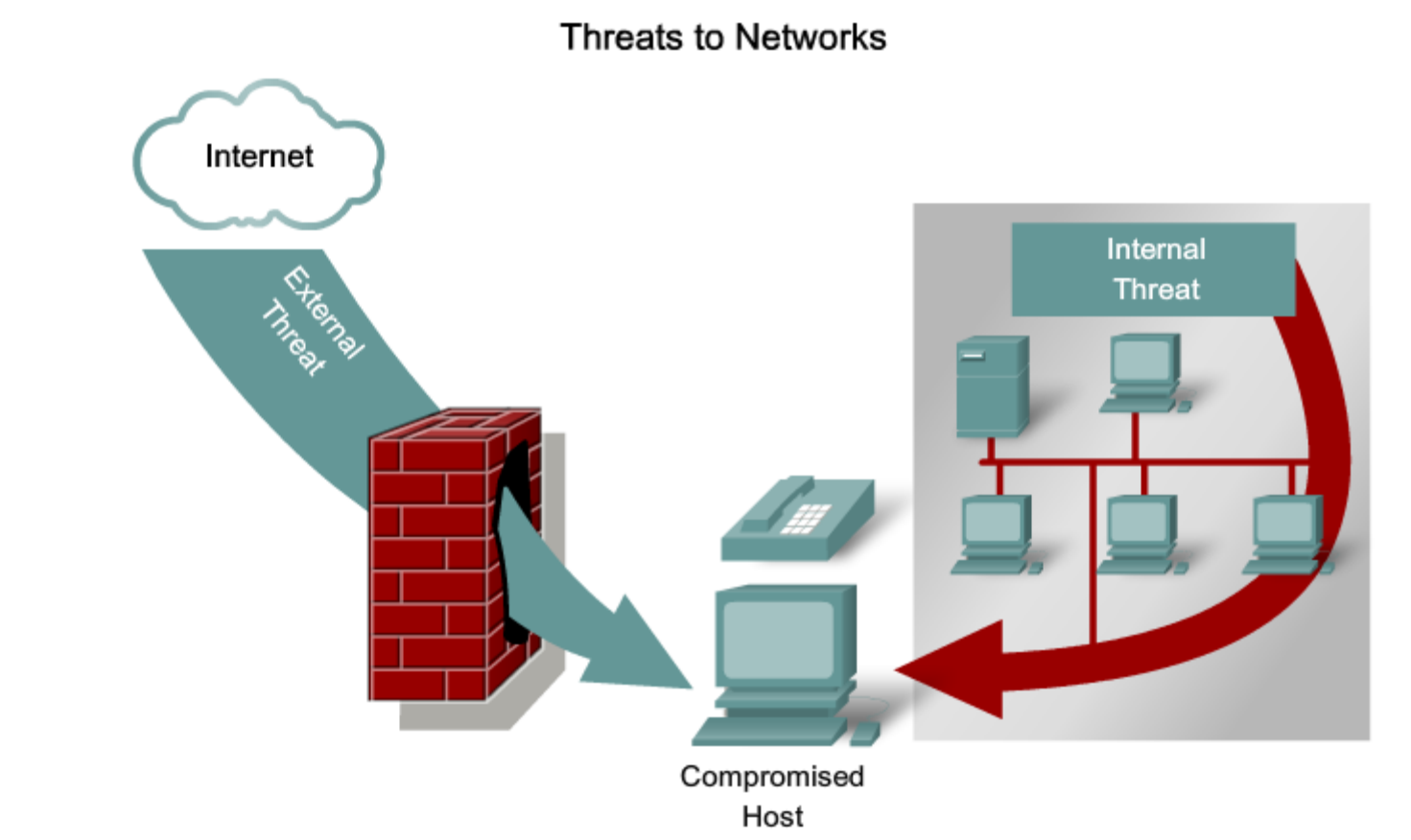
PROVIDING NETWORK SECURITY



The communication and information that we would like to be private is protected from those who would make unauthorized use of it.

FUTURE OF NETWORKING

NETWORK SECURITY



NETWORK SECURITY

SECURITY THREATS

The most common external threats to networks include:

- Viruses, worms, and Trojan horses
- Spyware and adware
- Hacker attacks
- Denial of service attacks
- Data interception and theft
- Identity theft

NETWORK SECURITY

SECURITY SOLUTIONS

Network security components often include:

- Antivirus and antispyware
- Firewall filtering
- Dedicated firewall systems
- Access control lists (ACL)
- Intrusion prevention systems (IPS)
- Virtual Private Networks (VPNs)